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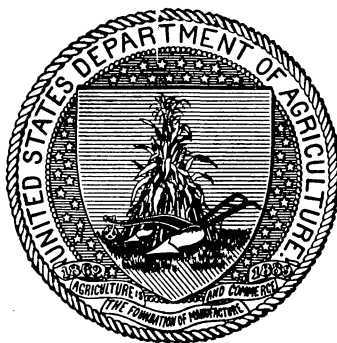
U. S. DEPARTMENT OF AGRICULTURE.

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FORESTRY IN NATURE STUDY.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., August 29, 1911.

SIR: In 1909 the Office of Experiment Stations, in cooperation with the Forest Service, published for distribution among teachers at the Alaska-Yukon-Pacific Exposition a circular containing a brief tentative outline for a course of forestry in nature study. The requests for that circular and the accompanying correspondence indicated a large demand on the part of teachers for more definite and detailed directions for utilizing trees and forests in nature-study exercises and courses. The circular has therefore been rewritten on the plan (1) of suggesting definitely what tree studies, exercises, and supplementary readings may be used each term in the first six years of the elementary schools, and (2) of making these lessons progressive and logical—this with a view to avoiding fragmentary, unrelated, and unprofitable work, which in the past has been characteristic of much of the public-school nature study. This is not an attempt to introduce scientific forestry into the primary and intermediate grades, but to furnish teachers a guide for the study of trees, with an occasional glimpse into the forest, so that the school children may learn to know and love trees, understand their needs, and comprehend, even though vaguely, their relations to homemaking and farming.

In addition to the course of study, the manuscript as now submitted contains a discussion of the aims of nature study and the methods of teaching it, suggestions for supplementary experiments, field trips, and the use of illustrative material, a key to the common kinds of trees, and a bibliography of the books referred to in the text.

The revision was made by Edwin R. Jackson, expert in the Forest Service, under the direction of Dick J. Crosby, specialist in agricultural education of the Office of Experiment Stations, and is transmitted herewith for publication as a Farmers' Bulletin.

Respectfully,

A. C. TRUE,
Director.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	5
The aims of nature study.....	5
The distinction between "tree study" and forestry.....	5
Methods of teaching.....	7
Outlines for a course of study.....	9
Primary grades.....	9
First grade.....	10
Fall: Leaf studies.....	10
Winter: Trees in winter. Winter buds.....	10
Spring: Tree blossoms.....	11
Second grade.....	11
Fall: Nuts and fruits of forest trees.....	11
Winter: Tree trunks, their coverings and uses.....	13
Spring: Tree seeds, germination.....	14
Third grade.....	14
Fall: The whole tree.....	14
Winter: Shapes of forest trees.....	15
Spring: The growth of the tree.....	16
Intermediate grades.....	16
Fourth grade.....	17
Fall: The forest. Tree families.....	17
Winter: The evergreens.....	18
Spring: Tree planting and gardening.....	19
Fifth grade.....	21
Fall: Reproduction of forest trees.....	21
Winter: Wood structures and uses.....	22
Spring: Forest influences.....	22
Sixth grade.....	23
Fall: Enemies of the forest.....	23
Winter: Forest industries and forests of the United States.....	24
Spring: The care and management of trees and forests.....	25
Twelve supplementary experiments.....	25
Suggestions for field trips.....	29
Suggestions for a forest calendar.....	32
Suggestions for a forest museum.....	33
Appendix.....	37
Supplementary reading books.....	37
Reference books for nature-study teachers.....	37
Key to common kinds of trees.....	39

ILLUSTRATIONS.

	Page.
FIG. 1. Rural school pupils studying forestry.....	7
2. An Arbor Day program beneath the apple trees.....	9
3. Flowering dogwood.....	12
4. The sycamore.....	13
5. Lombardy poplars.....	16
6. The forest floor.....	18
7. Evergreens in winter.....	19
8. Planting trees on school grounds.....	20
9. Junipers planted by birds.....	21
10. "Frogstools" indicate that decay has begun.....	24
11. A crooked old tree which should be removed.....	26
12. A trip to the woods.....	30
13. Method of mounting tree specimens.....	35

FORESTRY IN NATURE STUDY.

INTRODUCTION.

THE AIMS OF NATURE STUDY.

One of the chief aims of modern education is to make the child familiar with his surroundings and master of them. As Dr. G. Stanley Hall has said, "To know nature and man is the sum of all earthly knowledge." In order to accomplish these ends, present-day educators have come to devote a great deal of time and attention to systematic study and observation of natural objects, these general studies being classified under the head of "nature study."

The field of nature study is exceedingly broad. All the objects, elements, and phenomena which touch our lives and influence them may be considered as legitimate subjects for study. The possible lines of research are numerous and varied. Among all these possibilities it becomes the duty of the teacher to select those which are most worth while. Nature study has among its chief aims the incucation in the mind of the pupil of an appreciation and love of the beautiful; his training in acuteness of observation; the development of his reasoning powers by the application of these observations; and the improvement of his powers of expression. Few things in nature fulfill these requirements so well or contribute so fully to the accomplishment of these aims as does the forest. In the forest can be found a wealth of illustrative material; it is replete with myriad forms of vegetable and animal life, and the forest itself, as a whole, is living and active; it is full of the wonderful and the beautiful; it is teeming with lessons of interest at all seasons of the year; and, what is perhaps most important of all from a practical viewpoint, the material for these lessons is accessible to almost everyone. Individual trees alone furnish so many interesting and instructive features that they have come to be favorite subjects for nature-study lessons; but the broader study of the forest, while frequently lost sight of in the study of single trees, offers untold opportunities not only for useful instruction but also as a means of developing and holding the interest of the pupils and of training their keenness of observation.

THE DISTINCTION BETWEEN "TREE STUDY" AND FORESTRY.

It is well to keep in mind the distinction between forestry and "tree study" as commonly found in nature-study courses. "Forestry has to do with single trees only as they stand together on some

large area whose principal crop is trees, and which therefore forms part of a forest.”¹ It is not the single tree, but the forest, where trees are considered not singly but *en masse*, which must be studied in developing the element of forestry in nature study. The chief work of the forester is so to manage the forest that it will produce a paying crop or to preserve the forest from destruction for its protective influence. From this it will be seen that strict forestry is economic in its aims, while tree study, as usually carried on, is largely esthetic. The practical forester has little to do with the use or growth of ornamental trees, or even with tree planting as concerns merely individual trees. Such work properly falls to the landscape gardener or the horticulturist.

It would be manifestly unwise to attempt to teach scientific forestry, as such, to children in the lower grades. Even in the upper grades and the high school it must be very elementary in its character. Nevertheless, a great many of the general principles upon which scientific forestry is based may be brought within the comprehension of young children. To lead up to the more advanced subject of practical forestry, however, it will be necessary to familiarize the pupil with the life history of the tree and the processes of tree growth. Therefore, especially in the primary grades, tree study, with an occasional glimpse into the forest, should form the basis of the work. As the course develops, more and more time may be given to the forest and less and less to the tree. In the upper grammar grades the study of the forest naturally should be correlated with geography. In the high school, forestry properly claims consideration as a part of elementary agriculture, since the lessons of the wood lot and its management are too important to the farmer to be overlooked. In those high schools where agriculture is not taught as a distinct branch, a great deal of forestry may be taught in correlation with such subjects as physical geography, botany, and manual training. In fact, many of the features incident to the study of forestry must necessarily be considered in the regular work provided for in the ordinary school curriculum.² No attempt has been made in this bulletin to suggest any nature-study work above the sixth grade, since it seems desirable that all studies in forestry above this point should be correlated with other subjects, as previously suggested.

The studies outlined in this bulletin need not be given as continuous lessons, but may be taken up at various times during the year as time and opportunity offer. Possibly one period out of every five or six devoted to nature study may be given with profit to the study of the forest. In no sense is this outline intended to suggest that

¹ U. S. Department of Agriculture, Farmers' Bulletin 173, Primer of Forestry, Part I.

² Suggestive outlines for such work will be found in Forest Service Circular 130, "Forestry in the Public Schools."

forestry should supplant any other subject, but only to point out some of the interesting and useful things about the forest which every public-school pupil should know if he is to become a well-informed, useful citizen. These things should be used to supplement the regular work assigned to the classes, and will in this way prove helpful rather than burdensome.

METHODS OF TEACHING.

Educators are agreed that children should study *things* rather than *books*, and that these things should be such as are found within the child's ordinary environment. The young child learns almost entirely through the senses—it is busy learning the feel, the taste, the smell, the



FIG. 1.—Rural school pupils studying forestry.

sound, the looks of the things with which it comes in daily contact. Out of mere curiosity, or because of pure motor activity, the normal child is constantly impelled to new researches, and adds daily to its knowledge the results of its observations, imitations, and experiments. Obviously, then, the best way to teach forestry is to take the pupils to the forest (fig. 1). When it is impossible to go to the forest, specimens should be brought to the schoolroom for study. Suggestions for field studies and for making collections of specimens will be found elsewhere in this bulletin. (See p. 33.)

The more informal these lessons are, the better the results will be. Yet it is important that the teacher assume the task of directing and

guiding the pupils in their studies. This can be done effectively by means of stories, talks, and informal questioning. Children's literature is filled with interesting stories of the forest and its inhabitants, some of which are suggested in connection with the outlines in this bulletin. The proper use of these supplemental readings will without doubt prove of great benefit in increasing the interest of the pupils.

If trees are not accessible for study, the next best thing is perhaps a set of well-selected pictures which show forest conditions and various features of tree growth. Such pictures may be found frequently in magazines, geographies, and nature books.¹ An undoubted source of additional interest and instruction will be found in the camera, if one can be carried by pupil or teacher on excursions to the forest. The interesting things seen can then be photographed, and the pictures developed and labeled with descriptions telling something that has been learned about the object. These pictures may be pasted in an album or on a "forest calendar," to become the permanent possessions of the school. (See p. 32.)

The one most important requirement for the success of such work as this, as in all teaching, is the advance preparation of the lesson by the teacher. If a field trip is to be undertaken, the teacher should learn in advance where the class can be conducted to the best advantage and what may be expected from the trip. If specimens are to be collected, the teacher should know whether the material desired is available anywhere in the vicinity and if so how it may be most easily secured and how used to the best advantage. If an experiment is to be performed, the teacher should carefully go over the details in advance, and whenever possible perform the experiment, so as to know what results to expect and what difficulties and sources of error the pupils are likely to encounter. Nothing will be more disastrous to an undertaking of this sort than the lack of a definite plan of work on the part of the instructor. Without it the field trip degenerates into a picnic for the pupils and a tragedy for the teacher; while the classroom exercises will probably be more harmful to the discipline and spirit of the school than they are beneficial.

The outlines given in this bulletin are necessarily very general in character. If they are to be of practical use the teacher must localize the lessons. If the trees named for study are not to be found in the locality of the school, others must be chosen from local species and substituted for them. Exercises and experiments will have to be modified to suit local conditions. These things can not be done by anyone except the person actually on the ground in charge of the work. It is from this application of general principles to local conditions that the greatest benefit will be derived.

¹ Photographs of trees or forests may be purchased from the Forest Service, U. S. Department of Agriculture, at cost price plus 10 per cent.

OUTLINES FOR A COURSE OF STUDY.

PRIMARY GRADES.

The pupil entering the primary grades of the school is entering a new world. With the home and its surroundings he has already become familiar, but outside the home his experience is limited. The school, with its new regulations, new personalities, and new purposes, is to him strange and often bewildering. It is important, therefore, that his interest be caught from the beginning. To introduce complex or remote subjects for study would clearly be a



FIG. 2.—An Arbor Day program beneath the apple trees.

mistake. Simple objects—those with which he is already more or less familiar—should be chosen, about which he may learn new lessons. The tree, with its leaves, buds, and fruit, is an ideal source of such material, and the lessons here suggested are intended to bring out some new points of interest about the tree and its parts.

The chief aims of this work in the primary grades might be summed up as follows: (1) To teach an appreciation of the beauty of trees; (2) to impress the pupil with a sense of the usefulness of trees to man; and (3) to make the pupil familiar with common trees, so that he may be able to identify them at sight by form, bark, or leaf. The exercises outlined in the following lessons have been prepared with these aims in view.

FIRST GRADE.**FALL TERM: Leaf studies.**

Trees whose leaves are suitable for study:¹

Maple	chestnut	willow	walnut
Oak	sassafras	basswood	horse chestnut
Elm	catalpa	tulip-poplar	sumach

Exercises: Gather autumn leaves of trees common to the locality and bring them to the schoolroom. Sort these leaves into piles according to colors. Use bright-colored ones for making wreaths or borders for schoolroom decoration. Can you find any leaves which, as a rule, show brighter colors than those of other kinds of trees?

Select a leaf of simple form, trace or draw it on paper, and color the drawing with water colors, using the leaf itself as a guide.

Sort the leaves according to shapes and become familiar with the names of 8 or 10 common species, so as to be able to recognize them instantly upon sight.

Do you think it is true that "Jack Frost paints the colors on the leaves?" Watch the effect of a frost to find out. Note how quickly the leaves turn brown and fall from the twigs after a sharp frost. If the autumn is mild, without severe frosts, notice how brilliant the autumn leaves become. On the other hand, if there have been early frosts, point out how dull the colors are.

What becomes of the fallen leaves? Of what benefit are they to the seeds and roots buried in the earth, when they cover the ground beneath the trees through the winter?

*Supplementary readings:*²

How the Leaves Came Down. Susan Coolidge. (1, 9, 13)

The Anxious Leaf. Henry Ward Beecher. (1, 16, 23)

The Kind Old Oak. Selected. (8)

The Oak and the Violets. Selected. (18)

The Tree. Bjornstjerne Bjornsen. (8, 9, 13, 14, 16, 23)

Autumn Leaves. The Little Leaves. Geo. Cooper. (13)

October's Party. Selected. (13)

Falling Leaves. Selected. (18)

Nature's Byways. Numerous lessons. (10)

WINTER TERM: Trees in winter. Winter buds.

The following trees have buds suitable for study:

Horse-chestnut	elm	beech	cottonwood
Magnolia	boxelder	hickory	basswood

Exercises: Examine the "scars" on twigs where leaves were attached. What shape are these "scars" on the horse-chestnut? Does this suggest where the tree gets its name? Do all the trees lose their leaves through the winter? Are there some on which the dead leaves remain clinging in spite of winter winds? What do we call trees like the pine on which the leaves stay green all the year? What do we use these trees for at Christmas? Talk about the gifts which the trees bring to us every year—nuts, fruits, wood, etc. Talk about the work of the carpenter, the lumberman, the cabinetmaker.

Just before the buds begin to swell with the approach of spring bring to the schoolroom twigs with large buds and put them in water. Notice how, in a

¹ These trees are suggested because of the characteristic shapes or colorings of their leaves. Others may be substituted where these species are not found. It will be well at this point to avoid attempting to distinguish species of the same family, since this may be confusing. The selection of a single tree of each kind will simplify the studies and give more satisfactory results.

² Throughout the lists of supplementary readings given in connection with each term's work, the numbers following each title refer to the books listed on p. 37, Appendix, in which these selections may be found.

few days, if the room is kept warm, the scales will begin to open. Watch to see if you can discover the little new leaf folded within the bud. Compare the opened buds with others of the same kind brought from out of doors. Study how the scales protect the young leaf in its long sleep through the winter. Examine the scales. Are they smooth, gummy, or fuzzy? Do you think the down or gum you find on some buds would help keep the little leaves dry and protect them from cold?

For drawing lessons, use twigs with buds showing the scales and leaf scars.

Supplementary readings:

- The Baby Bud's Winter Clothes. Jarvis. (8)
 The Venturesome Buds. A. C. (13)
 How the Horse Chestnut Got Its Name. Boyle. (20)
 Buds. Chase. (6)
 Caps and Blankets. Selected. (18)
 Ruth and the Pine Tree. Selected. (18)
 Waking Too Early. Selected. (18)
 Where did the Willow Buds Come From. Selected. (18)
 Nature's Byways. Numerous lessons. (10)

SPRING TERM: Tree blossoms.

The following trees have blossoms suitable for study:

Red maple	elm	flowering dogwood	basswood
Pussy willow	oak	wild crab apple	magnolia
Catalpa	birch	tulip poplar	horse-chestnut

Exercises: Explain that the "tassels" of the oak and "pussies" of the pussy willow are really flowers. Now see how many different kinds of tree flowers can be found and brought to the schoolroom. Learn to know the blossoms of 8 or 10 trees (fig. 3).

Watch to see which appear first in the spring—flowers or leaves. Is this order the same for all trees? What insects visit the blossoms of the trees? What are they looking for? Which blossoms do they prefer? Which tree blossoms have no smell? Do the bees visit these as frequently as they do the sweet-scented ones?

Talk about the usefulness of trees for shade and beautification. Study the home building of birds and squirrels in the treetops and the habits of the woodpecker. Study how the leaves, branches, and roots of the trees afford hiding places and shelter to creatures that live in the forest.

For drawing lessons, use the pussy willow, dogwood, or tulip poplar blossoms as studies.

Supplementary readings:

- The Walnut Tree that Wanted to Bear Tulips. Wiltse. (7)
 Pussy Willow. Kate L. Brown. (8)
 Pussy Willow. Marian Douglas. (13)
 The Lilac. Clara D. Bates. (13)
 How the Apple Blossoms Came Back. Margaret Boyle. (20)
 The Apple Blossoms. Selected. (18)
 Nature's Byways. Numerous lessons. (10)

SECOND GRADE.

FALL TERM: Nuts and fruits of forest trees.

The following trees furnish material suitable for study:

Chestnut	beech	horse-chestnut	catalpa	crab apple
Walnut	hickory	oak	locust	wild plum

Exercises: Gather small branches bearing nuts or seed pods for study. As far as possible, connect the study of nuts with the leaf studies outlined for the first grade. Learn to identify as many trees as possible by their fruits.

Notice the husk, or outer shell, of the chestnut bur. What is it for? What do the squirrels do with these nuts? Would it be easy for a squirrel to get at a chest-



FIG. 3.—Flowering dogwood.

nut before the bur opens? Does the nut fall out of the husk or does husk and all fall from the tree? What is the effect of frost on nuts?

Carefully remove the shell from an acorn and examine the kernel. Into how many parts is it divided? Separate them, and see if you can find the little "sprout" hidden between them. Plant an acorn and see what comes of this.

Explain that the kernel of a nut is really the seed of the tree. Now compare the seeds of the locust or catalpa in their pods with those of the apple and plum in their fleshy coverings. How would you tell a *nut* from a *seed*?

What kinds of native nuts are sold at the grocery stores? Find out how much chestnuts, walnuts, and hickory nuts are worth per bushel. Where does the squirrel keep his winter supply of nuts? What nuts does he prefer? Make a list of all the different kinds of nuts and fruits which people like to eat. Can you think of any other articles of food produced by trees? Visit a grocery store and make a list of all the articles kept there which are obtained from trees.

Sketch a chestnut bur, a group of acorns, a hickory nut in its husk.

Supplementary readings:

Why the Juniper Has Berries. Holbrook. (3)

The Maple Sugar Story. Hopkins. (5)

The Chestnut Boys. (8)

Wait and See. Jarvis. (8)

The Chestnut Bur. Selected. (13)

Nutting. Selected. (13)

Little Nut People. Nicholson. (13)

The Gossip of the Nuts. Selected. (13)

The Apple Barrel. Edwin Sabin. (14)



Fig. 4.—The sycamore.

WINTER TERM: The tree trunks, their coverings and uses.

Sycamore	willow	slippery elm	locust
Shellbark hickory	beech	sassafras	prickly ash
Birch	silver maple	black cherry	Osage orange

Exercises: Study the appearance of the bark of trees in the vicinity of the school. What is the difference between the appearance of the old bark on the base of the tree trunks and the new bark on twigs and branches? On an old tree and a young tree? Describe the appearance of the bark on such trees as the sycamore (fig. 4), birch, and shellbark hickory. Learn to recognize 8 or 10 such trees by their bark. Taste twigs of slippery elm, sassafras, etc.

Notice the thorns of hawthorn or Osage orange. Break off a thorn. Does it grow only from the bark, or does the wood extend out into it? Do you think a tree armed with thorns would be so likely to be browsed or trampled by cattle as one without?

Make a list of household articles which are made from wood. What are corks made from? Tell in simple language how coal was formed. Discuss in a story

form all the different steps necessary to bring the tree from the forest and manufacture it into pencils, desks, lumber for building the schoolhouse, etc.

Read the story of "Hiawatha's Sailing" and notice how he called upon the trees for material to build his canoe.

Supplementary readings:

How Coal is Made. Wiltse. (7)

Hiawatha's Sailing. Longfellow. (11)

The Christmas Trees. Mary F. Butts. (9)

The Logging Camp. Jarvis. (8)

An Old Fashioned Rhyme. Selected. (8)

The Story of a Stick of Wood. Chase. (6)

The Stump Story; The Log Story; The Rail Fence Story. Hopkins. (5)

The First Christmas Tree. Field. (24)

SPRING TERM: Tree seeds, germination.

The seeds of the following trees either ripen in the spring, or may be kept in storage, or procured on the market, and thus may be available for study in the spring term:

Elm	oak	coffeetree	apple
Silver maple	catalpa	chestnut	peach
Cottonwood	locust	pine	plum

Exercises: Plant newly fallen seeds of elm or maple. Watch to see if they sprout at once or lie in the ground one season. Is this the same for all trees? How long after planting the seed is it before the little tree appears? How many leaves are there at first on the seedling? Do these look like the leaves of the big tree? Watch to see what becomes of these first leaves.

Look for little seedlings which frequently spring up beneath forest trees. Dig up one not more than 2 or 3 inches high and look for the remains of the seed from which it started. If the seedling is from a thick-shelled nut, such as the hickory or walnut, see if you can find out how the tender little seedling got out of the shell. Do you suppose Jack Frost helped it in any way?

Watch the trees to see where and when the seeds form. Learn to know as many as possible of the forest trees by their fruits. Learn whether the seeds ripen early or late.

Plant trees on Arbor Day. Talk about the trees in the school yard or vicinity and how they got there. Who attended the school when these trees were small? Tell how the food stored up in seed or nut feeds the little seedling until its roots get started in the soil and its leaves in the air.

Supplementary readings:

Apple Seed John. Child. (8)

The Maples' Story. Chase. (6)

The Tree that Tried to Grow. Francis Lee. (18, 23)

THIRD GRADE.

FALL TERM: The whole tree.

Renew acquaintance with trees already studied and add some new types, such as the ash, aspen, hackberry, mulberry, and sweet gum.

Exercises: Select some flourishing, dense-crowned tree which is easily accessible and study it. Learn the meaning of the following terms and apply them to this tree: Roots; stem; bole, or trunk; bark; sap; branch; spray; twig; leaf; petiole; foliage.

Watch the tree as it changes with the seasons. What color was it in summer? In autumn? Do the leaves fall early or late? Are the leaves found close to the trunk or near the ends of the branches? What is the reason they are spread out

in this way? How does the trunk help the leaves get to the light and air? What holds the trunk upright? How much of the roots can you see above ground? How far do you suppose they extend below ground?

Which trees grow in wet and which in dry places? Are there any caterpillars or insects on or around any of the trees studied? What is the difference between a tree, a shrub, a bush, and a vine? Do any other plants grow as large as trees?

What part of the tree is most used by men? Of what use to man are the leaves? The roots?

Make tree booklets. Include in them pictures of trees, drawings of leaves and fruits, interesting facts about these trees, quotations, etc.

Supplementary readings:

Forest Trees—Mother Truth's Melodies. (13)

Why the Aspen Leaves Tremble. Holbrook. (3)

The Oak. Geo. Hill. (14)

The Brave Old Oak. Chorley. (14)

Our Willows. (Hours at Home.) (16)

The Legend of the Maple. Ogden. (11)

The Red Maple. Thoreau. (11)

A Fairy Story; Philemon and Baucis; Daphne; The Poplar Tree. Cook. (2)

The Oak Tree and The Ivy. Field. (24)

WINTER TERM: Shapes of forest trees.

The following trees are easily recognized by their shapes or their sprays:

Elm	ash	catalpa	horse-chestnut	weeping willow
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Oak	birch	Osage orange	Lombardy poplar	Norway maple
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Exercises: Study the characteristic shapes of trees, such as those listed, and learn to recognize them by their form alone (fig. 5).

Point out the two distinct types of branching shown by the Lombardy poplar and the elm.¹ Make lists of the trees you know, classifying them as to this characteristic. Notice whether the twigs of the trees are thick and coarse, or divide up into fine sprays. Would a spray lie flat on the table or do the twigs spread out in all directions?

Observe whether these trees branch close to the ground, or if the trunks grow up tall and clean before branching. Do the branches grow out opposite one another or alternately along the trunk? Do they grow out horizontally, or tend upward or downward? Which trees are more likely to be injured by windstorms—the wide-spreading or erect types? Which make the best shade trees? Which trees produce the best posts, poles, and lumber—those with tall, clean trunks, or those with low branches?

Collect pictures of trees in winter, showing characteristic shapes, trees laden with snow. Make drawings in charcoal of general outlines characteristic of various trees.

Supplementary readings:

Miss Willow. Susan Kennedy. (13)

Three Trees. Selected. (13)

The Crooked Fir Tree. Pratt. (20)

The Silver Poplars. Selected. (18)

The Little Vine. Selected. (18)

Forms and Expressions of Trees. Flagg. (23)

¹ *Excurrent* type: Trunk can be traced up through crown to topmost twig; e. g., the Lombardy poplar. *Deliquescent* type: Trunk divides up into branches, so that no main central stem can be distinguished through the crown; e. g., the elm.

SPRING TERM: The growth of the tree.

Study growing trees. Green twigs of maple, boxelder, willow.

Exercises: Watch the forest trees for evidences of the spring awakening. What are the first changes you notice? Cut off a small branch of a maple or boxelder. What is the watery fluid which flows from the wound? Taste it.

Remove the bark from a green twig and notice the green, moist layer just inside the inner bark. This is what builds the tree. It is called the "cambium" layer. Examine the branch of a boxelder or maple. See if you can distinguish

last year's growth from that of the preceding year. Can you tell the new growth of the evergreen twigs from the old parts by the color?

Place a growing plant in the dark and notice the result after a few days. Make a mark on a rapidly growing young seedling at a certain height from the ground and see if the seedling lifts this mark higher in growing. At what season of the year do you think the tree grows fastest? What would be the effect of a cold spring season on tree growth?

Tell in simple way how the tree gets its food from the soil and air; how it is carried up the stem to the leaves to be digested there by aid of the sunlight; how it is sent down through the cambium to be built on the tree as an "annual ring."



FIG. 5.—Lombardy poplars.

Make a "Forest Calendar" on which to record the appearance of evidences of the spring awakening or characteristics of individual trees. (See p. 32.)

Supplementary readings:

The Tree. Jones Very. (13)

The Last Dream of the Old Oak Tree. Hans Andersen. (16)

The Diligent Tree. Selected. (19)

The Real Tree. Holmes. (23)

The Twig that Became a Tree. Anonymous. (23)

How to Make a Whistle. Anonymous. (23)

INTERMEDIATE GRADES.

The studies outlined for the first three grades have had to do almost entirely with simple features of individual trees. Those suggested for the next three grades include studies not only of trees

but of the forest, thus broadening the scope of the work. In the upper grades there will be taught, as the regular work of the school, such studies as geography, history, and composition. The forest affords valuable material which may be used to enrich and enliven these subjects. As much as possible, therefore, the teacher should correlate the exercises outlined in the following pages with the regular studies of the school.

It must not be forgotten that an important end to be achieved in all this work is to cultivate the pupil's powers of expression as well as his keenness and accuracy of observation. To know a thing from having seen it is worth while in itself, but to be able to tell others about it is a still greater accomplishment. For this reason especial attention should be given in the upper grades to both written and oral composition based on the studies of the forest. Numerous opportunities in this direction will be afforded by these exercises, such as writing reports of the field trips or experiments and descriptions of the trees and features of forest growth studied.

FOURTH GRADE.

FALL TERM: The forest.¹ Tree families.

The following trees may be studied and compared:

Silver maple	white oak	white elm	pignut hickory	paper birch
Sugar maple	red oak	red elm	shagbark hickory	river birch

Exercises: Compare trees of the same family, but of different species. Do not attempt too many different kinds. Try to be able to recognize and distinguish all the species of some family (as all the maples) found in the vicinity. Collect and mount the leaves of various species for comparison.

Visit the forest. Notice how the trees form a sort of canopy or roof with their branches and leaves. Observe the "understory" of sprouts, seedlings, and small plants. Examine the soil beneath the tree. Do you find partly decayed leaves in it? How do you suppose this loose mold is formed? Sink a spade into the soil beneath the trees and notice how thickly the roots lie in the earth (fig. 6).

Look about at the trees. Are they all of one species ("pure stand"), or is it a mixed stand? Examine a tree in the dense forest and one of the same species growing alone in an open space. What difference do you notice?

Point out how the forest is a society of trees; how the trees help one another by sheltering one another from windstorms and the hot drying sun; how they strive with one another for light, soil, etc. Tell how the forest trees not only protect one another, but shelter and protect birds, squirrels, and other animals which inhabit the forest. Write little stories imagining things that are going on in the forest every day.

Supplementary readings:

Under the Greenwood Tree. Shakespeare. (13, 17, 23)

The Summer Woods. Howitt. (13)

The Gift of the Olive Tree; The Linden and the Oak; The Little Maiden Who Became a Laurel Tree. Judd. (4)

The Autumn Woods. Bryant. (16)

The Old Oak. Selected. (18)

¹ Farmers' Bulletin 173 contains much information useful in connection with this subject.

A Story of the Forest. Smith, in "The Story Hour."

The Forest. Jefferies. (23)

WINTER TERM: The evergreens.

Trees for study: Pine	cedar	hemlock	holly
Fir	larch ¹	spruce	live oak

Exercises: Have the children gather sprays of evergreen and holly and bring them to the schoolroom for study and for decoration purposes. Use the design of the holly leaf and berry in borders and other Christmas decorations.

Sort sprigs of the various evergreens according to length, arrangement, and shape of needles. Learn to know at sight whether the spray is from a pine, a hemlock, a fir, etc. (See Appendix, p.39.) Draw a spray of pine needles. Note



FIG. 6.—The forest floor.

the cones which are found on nearly all evergreens. Remove a few of the scales from a pine cone and see if you can find the seeds which lie near the inner tips. Some of the evergreens have characteristic odors. Crush the needles and learn which ones.

Why may evergreens in general be called "cone-bearing trees?" Do the needles ever fall from the pine trees? Look under a pine tree and see. Call attention to the larch as a *deciduous cone-bearing* tree; to the holly and live oak as *evergreen broadleaf* trees. Note how the snowbirds and sparrows seek the shelter of the evergreens during storms. Which would make a better windbreak if planted about a home, an evergreen or a tree which sheds its leaves in winter?

The larch is not an evergreen, but is suggested for study here as a type of deciduous, cone-bearing tree.

Point out the advantage of the conical shape of the evergreen in shedding snow. How do trees keep the snow from drifting?

Learn the meaning of the following terms as they are used by the forester and lumberman: Conifer; evergreen; deciduous; broadleaf; hardwood; softwood.

Supplementary readings:

Why the Evergreens Never Lose Their Leaves. Holbrook. (3)

Holly. Susan Hartly. (13)

The Little Pine Tree. Eudora Bumstead. (13)

A Young Fir-wood. Dante G. Rossetti. (11, 17)

The Snowing of the Pines. Thos. W. Higginson. (17, 23)

The Little Pine Tree. Selected. (18)

The Secret of Fire. Cooke. (2)

The Fir Tree. Hans Christian Andersen (1)



FIG. 7.—Evergreens in winter.

The Little Fir Tree. Evaleen Stein. (1)

The Unhappy Pine Tree. Selected. (1)

The Pine Tree's Secret. Emilie Paulsson. (1)

The Voice of the Pine. Richard Watson Gilder. (23)

SPRING TERM: Tree planting and gardening.¹

The following species are suggested as desirable and may be obtained as suggested:

<i>Early seeds:</i>	<i>Stored seeds:</i>	<i>Seedlings:</i>	<i>Cuttings:</i>
Elm	locust	pine	willow
Silver maple	catalpa	spruce	cottonwood

¹ For further information, see Farmers' Bulletins 134, 228, 423; also Forest Service Bulletin 76, Circular 96, and Yearbook Separate 376.

Exercises: Test various kinds of tree seeds to see what percentage may be expected to germinate. (See p. 29.) Prepare a seed bed and sow tree seeds of various kinds. In each row plant a different kind of seed, marked by a stake with proper label. Keep records of time of sowing, time seedlings appear, and how well the seeds germinate.

Plant seeds at various depths in soil and learn at what depth they give best results. Soak some seeds in warm water before planting and plant others of the same kind without soaking. Which sprout better?

Make cuttings of willow and set them out in moist places. Watch for the development of roots and leaves on the cuttings. Where do they appear?

Transplant seedlings of various trees. Compare the roots of nut trees like oak or hickory with those of maple, catalpa, or the conifers. Which are easier to



FIG. 8.—Planting trees on school grounds.

transplant? Try the method of transplanting seedlings in tin cans. (See p. 28.)

Prepare a map of the school grounds and make a "planting plan" to show where trees should be planted to give best effect.

Learn the history of Arbor Day and talk about its significance to the nation. Discuss the supply of forests in the United States; the necessity for tree planting. Discuss the importance of tree planting for the beautification of cities and homes. Are many trees being planted nowadays in your city or on the farms in your locality?

Supplementary readings:

The Four Apple Trees. Selected. (8)

The Planting of the Apple Tree. Bryant. (11, 14, 17, 23)

What Do We Plant When We Plant the Tree. Henry Abbey. (14, 23)

Plant a Tree. Lucy Larcom. (14, 23)

An Arbor Day Tree. H. C. Bunner. (23)

A New Holiday. Curtis. (23)

Arbor Day. Jarchow. (23)

Arbor Day in Schools. Northrup. (23)

FIFTH GRADE.

FALL TERM: Reproduction of forest trees.

The seeds of the following forest trees illustrate adaptation for dispersal:

Boxelder	catalpa	black cherry	witch-hazel
Maple	ash	juniper	pine

Exercises: Collect specimens of various kinds of tree seeds and see if you can find out how they are scattered naturally. Examine winged seeds of boxelder and maple.

Throw some of these seeds up into the air in a strong wind and see how far they are carried. Now remove the "wings" from some of the seeds and throw up the seeds without their wings. Compare the distance these are blown with previous results.

Watch the wild cherry and juniper trees to see if the birds eat the fruit. Do they carry away any of the fruit? See if you can find seedlings planted by birds along fence rows (fig. 9). Watch a squirrel hiding nuts in the earth. Do you suppose he always comes back to get the nuts he has buried? What may happen if he doesn't?

Drop acorns and walnuts into a stream and watch to see if they float

or sink. Are they carried away by the water or rolled along the bottom?

If witch-hazel grows in the vicinity watch for the exploding of the seed pods and see how far the seeds are thrown. Make lists of trees whose seeds you think are scattered (1) by wind, (2) by water, (3) by birds or animals. Discuss the importance of leaving seed trees on lumbered land. Why do not all the seeds that fall from the trees grow? What enemies have these little seed babies?

Find stumps from which sprouts are growing. Do all trees sprout from their stumps? Make a list of all the trees you know whose stumps will sprout.

Supplementary readings:

The Oak and the Mistletoe Seed. Pratt. (16)

An October Talk. Selected. (18)



FIG. 9.—Junipers planted by birds.

- A Broken Branch. Selected. (18)
 Why Seeds Travel. Dana. (19)
 Winged Seeds. Dana. (19)
 The Chestnut and Other Seeds. Dana. (19)

WINTER TERM: Wood structures and uses.¹

The woods of the following trees will furnish interesting material for study and comparison:

Fir	soft pine	ash	maple
Cedar	hard pine	oak	basswood

Exercises: Get a cross section of a tree trunk or branch of oak or chestnut as large as convenient and observe heartwood, sapwood, and bark; annual rings, with summer wood and spring wood in each ring; pith rays; pores.

Count the annual rings. How old is the tree? Can you point out, from the annual rings, any years when the tree did not grow very well? Measure the diameter of the log. How many years did it take in growing that large? How fast, then, did it increase in diameter each year, on the average?

Find a tree in the forest whose lower branches are dead. Do they leave scars on the trunk when they fall away? If boards were cut from the trunk of this tree, what would these scars form in the boards? What shaped trees yield the best lumber?

Split or saw an oak stick lengthwise, smooth and polish the surface with sandpaper. Notice the "flaked" appearance of the surface. This "silver grain" is caused by pith rays.

Make collections of wood specimens. Notice whether all the specimens show different colors in sapwood and heartwood, and whether pores are visible in all of them. Do any of the woods have noticeable odors?

Visit lumber yards, sawmills, planing mills, etc. Study the life of the lumberman and the commercial use of lumber. Discuss the importance of wood as a building material and its other uses by man and the necessity for prevention of waste in use of trees.

Review the readings of legends and myths about trees and write what you remember of them. Learn all you can about trees famous in literature or history.

Supplementary readings:

- Wood. (Chapter V, Elementary Woodworking.) Foster.
 Wood. (In Part III, First Book of Forestry.) Roth.
 The First Christmas Tree. Henry Van Dyke.
 A Taste of Maine Birch. Burroughs. (11)
 Trees of History and Mythology. Sheldon. (16)
 The Washington Elm. Dame. (11)
 Under the Washington Elm. Holmes. (11)
 Some Famous Elms of New England. Holmes. (11)
 The Legend of the Oak. Selected. (11)
 Rhoecus. James Russell Lowell. (11)
 The Aspen. Ingeman. (11)

SPRING TERM: Forest influences.²

Exercises: When the snow begins to melt in the early spring watch to see whether it disappears more rapidly in the woods or in the open fields. Why is this? Place

¹ See U. S. Department of Agriculture, Forest Service Bulletins 10, 95, 99.

² See U. S. Department of Agriculture, Forest Service Circulars 168 and 176 and Bulletin 86; also Year-book Separate 329.

thermometers, one in the shade of the woods and one in the open, and compare the readings frequently during the spring. Which one registers the higher average temperature? What does this indicate?

After a rain notice how the raindrops cling to the leaves of the trees. Does the rain beat as hard upon the ground beneath trees as on open fields? From which does the rain water run off more rapidly, an open field or one covered with forest? What effect, then, would forests have upon floods?

Find a tree recently uprooted by the wind. Are the roots totally bare or are they loaded with soil? Why does the soil cling so firmly to the roots of trees? Pull up a small seedling tree and wash the soil from its roots. Does it come away easily? Do you think trees will help prevent erosion? Do you know of any places where trees have been planted in ditches to prevent the washing of soil?

Study the forest floor again. Do you find traces of decayed leaves in the soil? Compare the color of this top soil (humus) with that deeper down. What makes the difference? What do you conclude from this is the influence of forests on soil?

Where is the air purer—in the forest or in a large city? Discuss fully the importance of windbreaks to the prairie farmer in moderating winds.

Write a composition on how the trees serve man.

Supplementary readings:

An April Day. Longfellow.

The Pine Tree. Selected. (18)

Pine Trees. Ruskin. (11)

A Forest Hymn. Bryant. (11, 23)

The Forest as a Protective Cover. Roth, in First Book of Forestry.

When the Green Gets Back in the Trees. Riley. (23)

Relations of Trees to Water. Flagg. (23)

SIXTH GRADE.

FALL TERM: Enemies of the forest.¹

Exercises: Look for trees in the forest that have begun to decay. See if you can find any break in the bark or a wound of some sort where the decay started. Now find some tree from which a branch has been smoothly cut, close to the trunk. Is this wound healing? How is it being covered? What does this teach about how to prune trees?

Cut into a pine tree and watch to see how the tree slowly tries to cover the wound by pouring rosin over it. Look for globules of gum over broken places in the bark of the black cherry, spruce, or balsam fir.

Do you know of any hollow trees in the neighborhood? Does the tree die just because its heart is decayed? Will it resist the wind as well as one whose heartwood is sound? Do you think a tree could live without *any* heartwood, if it would not blow down? Look for "frogstools" on trunks of trees that are beginning to decay (fig. 10).

Watch to see which trees are attacked by insects. Look for caterpillar webs on trees. Do the limbs on which the webs appear seem to be injured as a result? Watch for the beetles that feed upon the leaves and bore in the bark and wood of certain trees. What birds destroy these insect pests? Ought we to protect these birds?

¹ See U. S. Department of Agriculture, Forest Service Bulletins 10, 82. See also publications of the Bureau of Entomology on insect enemies of the forest.

Observe the conditions of the forest floor after the leaves have fallen from the trees. Is there any danger of fires at this period? Touch a match to a bunch of dead pine needles and see if they will burn? Is there more danger of fire in a pine forest than in hardwoods? Watch the newspapers for accounts of forest fires. Study how these fires originate, how they are fought, the extent of the damage they do. How does the United States Government provide for preventing and

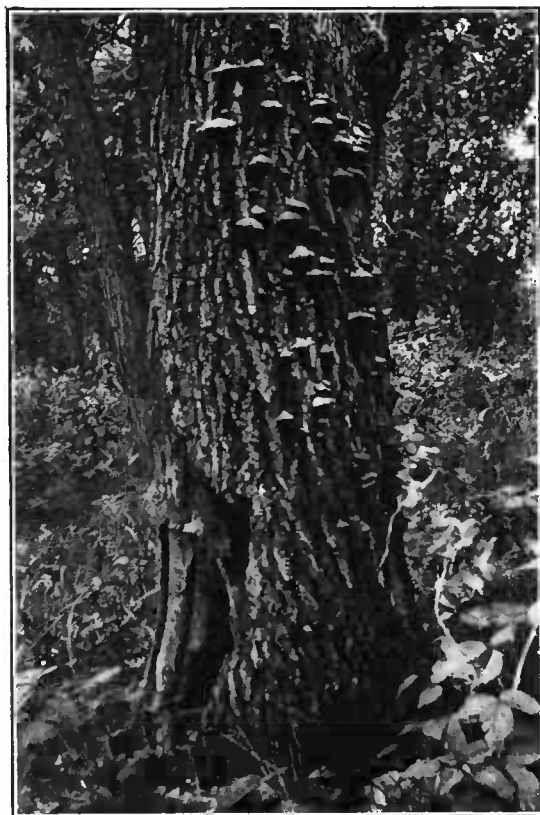


FIG. 10.—“Frogstools” indicate that decay has begun.

fighting forest fires? What are the forest rangers? Learn about their lives and duties.

Supplementary readings:

Woodman, Spare That Tree. Geo. P. Morris. (11, 23)

A Sermon from a Thorn Apple Tree. Emily Miller. (16)

The Happy Little Birch Tree. Selected. (18)

Forest Trees. Washington Irving. (11)

The Beech Tree's Petition. Thos. Campbell. (11, 23)

A Protest Against Felling the Trees. Wordsworth. (11)

WINTER TERM: Forest industries and the forests of the United States.¹

Exercises: Make a complete list of all the different trees you have found and identified in your locality.

Are these principally

conifers or broadleaf trees? In what regions of the United States are the forests chiefly coniferous? Where are the most important broadleaf, or hardwood, forests of the United States? Show these by colors drawn on a map on the blackboard or on paper.

Discuss the various industries in this country which depend upon the forests. Learn how paper is made; how leather is tanned; how turpentine, resin, wood alcohol, charcoal, etc., are obtained; how maple sugar and sirup are manufactured.

Collect samples of various forest products, such as wood pulp, tan bark, maple sugar, crude turpentine, etc., for a forest museum. (See p. 35.)

Learn the present extent of the forests of the United States as nearly as possible. How fast are they being cut down? Do you think they will grow up again as fast

¹ See Report of Forester; U. S. Department of Agriculture, Forest Service Bulletin 83 and Circulars 167, 171; also Farmers' Bulletin 252.

as they are cut? What materials are to-day being used instead of wood in buildings, sidewalks, bridges, fences, etc.? What substances may be used to make posts and other timbers last longer? Is this worth while?

What are the National Forests? Where are they situated? Why are they maintained? How are they controlled? How may the timber on these forests be cut and used? What privileges have settlers in the National Forests as to the use of timber, grass, water, etc.?

Supplementary readings:

From My Arm Chair. Longfellow. (11)

The Maple Tree's Surprise. Mann. (8)

Mr. Maple and Mr. Pine. W. J. Brier. (11)

The Logging Camp; Going Down the River; At the Sawmills. Bradish. (18)

Winter Trees. Wm. A. Quayle. (13)

The American Forests. John Muir. (23)

SPRING TERM: The care and management of trees and forests.¹

Exercises: Visit the woods, where trees are being cut for logs or posts. Take a small area where the trees are thick and mark those you think should be removed to give the best conditions for the growth of those remaining. In doing this look for defective trees; large trees of undesirable species overshadowing smaller ones of better kinds; trees which have obtained their full growth, or nearly so, which may be removed to give more light to younger, growing trees (fig. 11).

Are the stumps of trees that have been cut low or high? Is there any good wood left in them to go to waste? What has been done with the tops of the trees that have been cut? Has any wood been wasted in them?

Is there any young growth, or reproduction, in this forest? Where do the young trees grow best—under a heavy growth of larger trees or in the clearings? Do these trees produce sprouts from their stumps?

Do the farmers of the neighborhood make a practice of allowing cattle or sheep to graze in their wood lots? Do the cattle or sheep browse the leaves of the young growth? Do they injure the young trees by trampling or rubbing? What do you think of the plan of using a wood lot for grazing purposes?

In a city observe the care taken of street trees. When are they pruned? Why is early spring the best time? Are the young trees protected by guards? Why? Do you find any trees injured by pavement being laid too closely about them? What trees do you think are best for street planting? Why?

Review what has been learned about the various individual species of trees, and learn all you can about their characteristic features, growth, uses, etc.

Supplementary readings: Various readings from—

Ten Common Trees. Stokes.

Trees in Prose and Poetry. Stone and Fickett. (11)

First Book of Forestry. Roth.

Talks on Trees. Holmes. (23)

Wood-notes. Emerson. (23)

A Discourse on Trees. Beecher. (23)

TWELVE SUPPLEMENTARY EXPERIMENTS.

[These experiments may be used whenever time allows, to supplement the work outlined for the intermediate grades.]

¹ See U. S. Department of Agriculture, Farmers' Bulletins 228, 358; also Silvical and Planting Leaflets, Forest Service.

EXPERIMENT I. How to make leaf prints.¹

The materials needed for this exercise are a large smooth slate or piece of thick glass about 10 by 12 inches in dimensions; a tube of printer's ink; two 6-inch rubber rollers



FIG. 11.—A crooked old tree which should be removed.

such as photographers use in mounting prints; and several sheets of good quality white paper.

¹ The author is indebted to Mrs. Anna B. Comstock of Cornell University for this exercise. Mrs. Comstock gives credit to Prof. W. W. Gillett for the idea.

To make a print, squeeze a few drops of the printer's ink from the tube upon the glass or slate and spread it about with the roller until there is a thin, smooth coat of ink both upon the plate and upon the roller. The ink should never be so thin that it will "run," since it will not then produce a good, clear print. Now place the leaf on the inky surface of the glass and roll it once or twice on the upper side with the inky roller, until both surfaces of the leaf are well inked. Lay the inked leaf upon a sheet of smooth white paper and cover it carefully with another sheet. Take the *clean* roller and roll it *once* only, bearing on *hard*. An impression of the leaf will be made on both the upper and lower sheets of paper.

(For the older pupils, this exercise may be amplified and made much more interesting by using oil colors, which may be brushed lightly over the lower side of the leaf, or spread upon the smooth surface within a sketched outline of the leaf and the leaf then pressed upon them by a roller. The impression on paper is then made by rolling the "painted" leaf with a clean roller on white paper as in the printer's ink process. The lower side of the leaf gives a better print, with this process, than the upper. The colors used should be arranged just as they appear in the leaf itself.)

EXPERIMENT II. To show how the sap travels up the stem.

Color a glass of water with a good quality of red ink. Place some cuttings of live branches of maple or willow in this water over night. The next day split one of the branches and notice how the colored fluid has been drawn into and up these stems. Has it traveled upward in the bark, sapwood, or heartwood?

EXPERIMENT III. To store acorns or nuts for spring planting.¹

Gather a quart or more of acorns or nuts. Spread them out on a dirt floor in a cellar or shed for two or three weeks to dry. Then prepare a pit, on some well-drained spot, in which to store them. Make the pit about 14 inches deep and 10 or 12 inches square. Line the sides and bottom of the pit with boards or sink a box of the proper size into the hole, to keep out mice and squirrels. Cover the bottom with a layer of clean sand 2 or 3 inches deep. Spread a layer of nuts on this, then another layer of sand, and so on until all the nuts are stored. Then cover the whole with earth to a depth of from 4 to 6 inches, and see that it is well heaped up and rounded so as to drain off all water. Cover the mound thus formed with a roof of boards or shingles. When the ground is ready for planting in the spring remove the nuts from the pit and plant them immediately.

EXPERIMENT IV. The food of a tree.

Bore a hole one-half inch in diameter and 1 inch deep into the trunk of a hard maple, early in February before the sap begins to flow. Make a spout to fit this hole by forcing the pith out of a section of the stem of an elder and fit this spout tightly into the hole. Place a pail under the spout to catch the sap which flows from the spout. Measure the flow for each day for a number of days. When several quarts of sap have been secured place it in a pan and boil it down until it is a thick sirup, then allow it to cool. Watch for the sugar to form. Where did this sugar come from? What use has the tree for such substances?

EXPERIMENT V. To show the effect of girdling a tree.

(Select for this experiment some tree which is to be cut down. Do not try it on a good tree which should not be injured.) Early in the spring remove a strip of bark 2 inches wide clear around the trunk of the tree, leaving the wood entirely exposed. Be sure to cut through the inner bark so as to leave none of it connecting the bark

¹ For more complete directions as to storage of seeds, see U. S. Department of Agriculture, Farmers' Bulletin 423.

above the girdle to that below. Watch the effect on the tree. Does it show signs of injury immediately or not until late in the summer or the next spring? What is the result eventually? Explain.

EXPERIMENT VI. To show that trees give off surplus water through their leaves.

Cut about 6 inches from the tip of a growing, leaf-covered twig of some broadleaf tree, such as a cottonwood, maple, or basswood. Thrust the butt of the twig through a tight-fitting hole in a sheet of cardboard into a glass of water. Cover the twig with an inverted glass wiped clean and dry. Let stand for 12 hours. Note the moisture which gathers in the inside of the inverted glass. Try the same experiment after stripping the leaves from a twig. Where did the moisture come from which appeared on the glass in the first experiment?

EXPERIMENT VII. To transplant seedlings by "tin-can" method.¹

Get some small, thrifty seedlings about 6 or 8 inches high, growing in nursery beds or in the open, if possible. Dig them up carefully, allowing as much earth as possible to remain clinging to the roots. Get some tin cans, such as tomato cans, in which to plant the seedlings. Across the bottom of the cans make two cuts at right angles to provide drainage and allow the roots of the seedlings to escape. Place the seedlings in the cans and fill in rich earth until they are firmly planted in the cans. They may now be kept in the schoolroom windows if the cans are set in a trough or tray so that the little trees can be watered and tended like ordinary plants. In the spring set out cans and all in places where it is desired to plant trees. The cans will soon rust away and the little trees will continue to grow unchecked.

If desired, seeds can be planted in the cans and the trees grown in this way instead of transplanting the seedlings to the cans.

EXPERIMENT VIII. To estimate the height of a tree; "shadow method."

Set a short pole in the earth near the tree so that the shadow of the pole will fall on ground the slope of which is as nearly as possible the same as that on which the shadow of the tree falls. Measure the height of the pole from the surface of the earth, the length of the shadow it casts, and the length of the shadow cast by the tree. The height of the tree may then be computed as follows: Multiply the length of the tree's shadow by the height of the pole, and divide the product by the length of the pole's shadow.

The proportion may be expressed thus: The height of the pole is to the length of its shadow as the height of the tree is to the length of its shadow.

EXPERIMENT IX. To show where the increase in height takes place in trees.

In the early spring find a vigorous sapling, 2 feet or more in height, with smooth bark, such as a young hickory, box elder, or cottonwood. Cut a notch in the bark at a given height above the ground and another notch about a foot above the first. Record the exact height of the first notch and the distance between it and the second. Now measure the height of the sapling to the topmost terminal bud. Return to the sapling in the autumn and repeat the measurements. How much has the tree increased in height? Has either notch been lifted from the ground? Have the notches grown farther apart? Where has the new growth taken place? Do you think that the tree in growing pushes its whole trunk upward—stretches that part already built—or merely adds on to its height at the top? After a branch has developed from the trunk, would it be lifted higher from the ground by the growth of the tree?

¹ This exercise is suggested in California Agricultural Experiment Station Circular 59, by E. B. Babcock and Harry A. Greene.

EXPERIMENT X. To show how a tree increases in diameter.

Early in the spring select a young, vigorously growing tree, 3 to 4 inches in diameter, with a thin bark which peels easily; for example, a willow or a box elder. With a sharp knife make a horizontal cut through the bark about 1 inch long. From each end of this cut make a vertical slit extending upward about $1\frac{1}{2}$ inches. Carefully peel back the flap of bark thus loosened (being sure to expose the sapwood) and place a thin sheet of tinfoil beneath the bark on the exposed surface of the wood. Turn the bark back into its place and seal up the incision with grafting wax. Examine the tinfoil at the close of the growing season. Has the deposit of new wood appeared on the inside or the outside of the tinfoil? Which part, then, builds the tree—the cambium layer or the sapwood? How thick is the layer of wood built this season?

EXPERIMENT XI. To test the vitality of tree seeds.

Gather a quantity of small seeds, such as those of elm or maple. Count out from 50 to 100 seeds and place them on a plate between two sheets of moist blotting paper. Record on a slip of paper the number and species of the seeds with the date on which the test is begun. Place this slip on the edge of the plate so it will not get lost or separated from the seeds it represents. Cover the whole with another plate or a pane of glass. Keep in a warm room, in which the temperature is not less than 68°. Keep the blotting paper moist, but not saturated. Examine the seeds every day until all have had time to germinate. This may take two weeks or even longer. When the seeds are well sprouted, count out those which failed to germinate and from this determine the percentage of good seeds.

EXPERIMENT XII. To show that forests prevent erosion of the soil.

Prepare a mound of loose, fresh earth about 2 feet in diameter at the base and from 12 to 14 inches high. Pack the mound quite solidly, so as to approximate the natural condition of the earth's surface. Cover one side of this mound with moss, being careful to leave none of the surface exposed. Thrust small twigs of evergreen into the moss so as to make a miniature forest on one side of the mound. Leave the other side bare. Now with a common garden sprinkling pot sprinkle water upon the mound, first on the "forest" side, then on the barren side, from a height of about 3 feet or more. Note how the water gullies the bare slope, running off in muddy streams at the base of the mound on this side, while on the other, the "forest-covered" slope, is protected from erosion and the water remains clear. Note also that when the sprinkling is begun the run-off is more rapid from the barren slope than from the moss-covered side. What does this show as to the possible effect of the removal of forests from mountain sides?

SUGGESTIONS FOR FIELD TRIPS.

Field trips furnish at once the best and the most difficult means of studying the forest. They enable the pupil to study the trees at first hand in their natural state, which is without doubt the ideal method. (Fig. 12.) But this method is difficult, because the pupils generally feel that the discipline of the schoolroom relaxes as soon as the threshold is crossed and that study is impossible without the necessary accompaniment of books. It is no easy task to train young children, accustomed to the order and routine of the schoolroom, in the art of outdoor study. An outdoor lesson, therefore, will require the most careful preparation if it is to yield results commensurate with the effort and time required.

An aimless trip is likely to be a disastrous one. The first duty of the teacher then is to lay out a careful plan for the undertaking. To

do this, it will be advisable, if not necessary, for the instructor to go over the ground in advance, looking for features which may be studied with a view to economy of time, effort, and distance to be covered on the coming trip. A memorandum should be kept of special features which may be called to the attention of the pupils. This will enable the instructor to refresh his memory on important details and prevent embarrassing and time-wasting delays. This advance trip will also serve to increase the teacher's stock of information and arm him with a reserve fund of knowledge better than he can obtain from any reference books which he may consult.

In some localities the first problem will be to find a satisfactory place to which to conduct the pupils—a place that is easily reached



FIG. 12.—A trip to the woods.

where material suitable for study may be found. In other localities choice must be made of several possible routes. Much will depend upon the forest conditions of the vicinity as to the nature of the work planned. Of course it is highly desirable that a large tract of closely wooded land be the field of operation, but even if a few trees along some stream are all that can be found there will still be opportunity to teach some of the elementary principles of forestry.

Having decided on a route to be followed, the next step will be to plan the equipment for the trip. In most cases no tools will be neces-

sary but a sharp hatchet, a spade, and several sharp jackknives, such as every boy habitually carries. A market basket should also be provided in which to carry home specimens. A camera will lend additional interest to the occasion and enable the possessor to bring back pictures which will refresh the minds of the students and permanently illustrate the lessons learned. A magnifying glass or hand reading glass of moderate power is also desirable.

The most important step, however, in getting ready for a field trip is the preparation of the minds of the pupils. They must be interested to a point where they will look forward to more than a mere pleasurable excursion. The trip must seem to them an unusually interesting sort of lesson, but nevertheless an actual part of their school work.

The experience of most teachers has probably been that children are easily interested in anything which partakes of the nature of a story. As a means, then, of catching the interest of the pupils, it is a good plan for the teacher to give a series of simple talks about trees and their habits, bringing out in this manner as many as possible of the features which the pupils will have opportunity to observe on the trip. Tell them that if they look carefully they may see these things for themselves. Encourage a spirit of friendly rivalry among the pupils to see who can find the things mentioned first and who can report on the largest number.

Each child must feel that he is to be held responsible for this lesson quite as much as if it were from his books. Some sort of a report or composition, based on the things seen and learned, should be required of at least the older pupils. Each of these trips can usually be made the basis of several lessons in composition and will thus serve a double purpose. With the younger pupils the same end can be achieved by oral discussions of the features studied.

One other thing should perhaps be mentioned. A great lesson which should be taught to every pupil is the proper care and preservation of the forests. All studies of this sort should be thoroughly constructive, and never destructive. Make it a rule, therefore, never to dig up a seedling which promises to develop into a useful tree, unless it is to be transplanted to a better location. Never cut a branch that there is no reason for cutting—there are plenty that may be cut and the trees from which they are removed left the better for the pruning. Be careful, also, in cutting such limbs, not to leave ragged, projecting stumps which may make wounds the trees will be unable to heal over and thus cause decay and permanent injury to the tree. Care in this respect will more than repay any effort in discipline it may cost.

SUGGESTIONS FOR A FOREST CALENDAR.

Get some sheets of 3-ply bristol board or mounting board and cut them into sheets of a size which will be convenient for a wall calendar—for instance, 8 by 10 inches. Prepare one sheet for each month. A pad containing the calendar dates may be purchased for a small sum at any stationery store. The pages containing the dates for the various months may be separated and one mounted on each page of the calendar.

Now select some phase or condition of forest life, suitable for study each month. Select, also, certain trees which typify this phase or condition. One tree may be studied each month, or each week, as time offers or inclination permits. The following topics and trees are suggested. Others may be substituted, as desired.

September: "Leaf Fall."

Trees: Walnut, post oak, holly, larch.

October: "The Fruits of Forest Trees."

Trees: Chestnut, hawthorn, Scotch pine, juniper.

November: "The Coats of Forest Trees."

Trees: Sycamore, shagbark hickory, birch, honey locust.

December: "Shapes of Forest Trees."

Trees: White elm, Lombardy poplar, balsam fir, weeping willow, juniper or red cedar.

January: "Lumber from Forest Trees."

Trees: White pine, white oak, cypress, hickory.

February: "Miscellaneous Products of Forest Trees."

Trees: Longleaf pine, sugar maple, tanbark oak, spruce, hemlock.

March: "Tree Planting."

Trees: Pin oak, jack pine, catalpa, ginkgo.

April: "Tree Blossoms."

Trees: Flowering dogwood, red maple, tulip-poplar, magnolia, wild cherry.

May: "Leaves of Forest Trees."

Trees: Aspen, horse-chestnut, cedar, hemlock.

June: "Seeding of Forest Trees."

Trees: Cottonwood, boxelder, basswood, cherry.

The calendar may be used to illustrate these topics in various ways. One way would be to mount on each of the pages of the calendar pictures of one or more of the trees listed under each month, and to write opposite each picture a description of the tree and the interesting thing which it stands for in relation to the topic assigned for that month. For example, in connection with the general study of "Leaf Fall" in September, it could be pointed out that the walnut is a typical deciduous tree; the post oak is a deciduous tree whose leaves, while dying each autumn, frequently cling to the twigs through the winter; the larch is a type of deciduous, cone-bearing tree; while the holly is an evergreen, broadleaf tree.

Additional facts of interest about each tree may be recorded on the calendar. The pupils should be encouraged to watch for peculiari-

ties in the habits of various trees and report them to the school; as for example, when the tree blossoms, when the leaves and fruit appear. Each pupil thus contributing to the calendar might be rewarded by the entry on the calendar of the fact discovered, together with his name as the first one to report it.

In addition to this material, facts concerning the forest in general, learned through actual observation, should also be entered. The teacher may also select from literature quotations about the trees being studied for the pupils to memorize. After each tree has been thoroughly studied, a good supplementary exercise in composition may be had by asking the pupils to write out in story form all they have learned about the tree.

Where pictures can not be obtained, leaves of trees may be pressed and mounted upon the calendar pages; or specimens of the wood used in the same manner; or leaf prints made in the manner suggested on page 26 of this bulletin may be used. If there is a pupil of artistic talent in the school, water-color drawings of trees, leaves, or fruits will make beautiful contributions to the calendar.

When completed, the calendar may be hung upon the school walls as a souvenir, and it will not only be interesting from that standpoint, but will be instructive as well, and extremely useful for reference by future pupils and teachers.

SUGGESTIONS FOR A FOREST MUSEUM.

Nothing can be of greater benefit to a pupil who is studying about the products of the forest than actually to see and study these products, both in the raw and the manufactured forms. It will be well worth while, therefore, for any school which attempts to study the forest in any manner whatever, to begin at as early a date as possible to collect samples of forest products and other materials which will give information about the industries in which these products are used or manufactured.

Specimens for such a collection may be obtained from various sources. Some may be obtained directly from trees in the vicinity. The local grocery stores, drug stores, or hardware stores will supply a great many. Others may be obtained by exchange with schools in other localities if it is possible to get into communication with them. If enough local interest is aroused in the subject, it will frequently be found that patrons of the school will contribute to the project either by helping to bear the expense or by donating material.

The success of the undertaking will depend largely on how the specimens collected are prepared for use. First of all, they should be carefully labeled so as to tell exactly what the articles are, where they were produced in the raw state, from what trees procured, their

use commercially or otherwise, and any other information desirable for reference. Specimens of manufactured products should be arranged in series to show the processes and stages in manufacture wherever possible. A suitable case or cabinet with glass front, dust-proof if possible, will be found extremely desirable in order to protect the specimens from handling and from dust when not in use. If a suitable cabinet can not be procured ready-made, one can easily be made by any carpenter or cabinetmaker.

COLLECTIONS OF WOOD SPECIMENS.

The pupils should be encouraged to make collections of specimens of woods found in the locality of the school. A number of possible ways of preparing and mounting such specimens will doubtless suggest themselves, but the following method is recommended as likely to prove convenient and satisfactory.

1. Whenever possible, use seasoned woods for the specimens. If nothing but green wood is available, cut rough sticks and allow them to dry as thoroughly as possible before preparing the finished specimen.

2. Collect specimens as nearly as possible uniform in size and character as to the parts of the trees and ages of the trees from which they are taken. If some are taken from the branches and some from the trunks, or some from young saplings and others from old trees, they should be marked accordingly.

3. For each specimen, select a stick about 2 or 3 inches in diameter and cut from it a section about 4 inches long, sawing the ends squarely across. Split or saw this block through the center and smooth the split or sawed surface so as to show the grain longitudinally. Beginning about 1 inch back from the end on the bark-covered surface, cut with a sharp knife out to the end at the flattened surface, so as to slope one end. Now, if the wood is thoroughly dry and well seasoned, sandpaper the flat surfaces well. If it can be done, it will add to the appearance of the specimen to apply a single coat of thin varnish or shellac, so as to bring out the grain. The specimen is now ready for mounting.

4. Probably the best plan to follow in mounting a specimen is to insert a small screw eye into the square-cut end of the block prepared as above described, and hang it on a hook in the wall or in a cabinet. This will make it possible to take the specimens down for use in the classroom. It will also be possible to pack them in a small space, if it is desired to move them about. Another fairly satisfactory method of preparing and mounting specimens is shown in figure 13.

5. Great care should be taken to see that each specimen is properly labeled. When the sections are first cut they should be carefully marked so as to make it easy to identify each one, and these marks

should be kept on the specimens until they are finally labeled. The label should state the name of the tree; whether taken from trunk or branch; whether from an old tree or a sapling; locality and habitat; and, possibly, a brief statement as to the uses of the wood, especially in the case of woods like hickory or oak which are used in making implements, furniture, or other special articles.

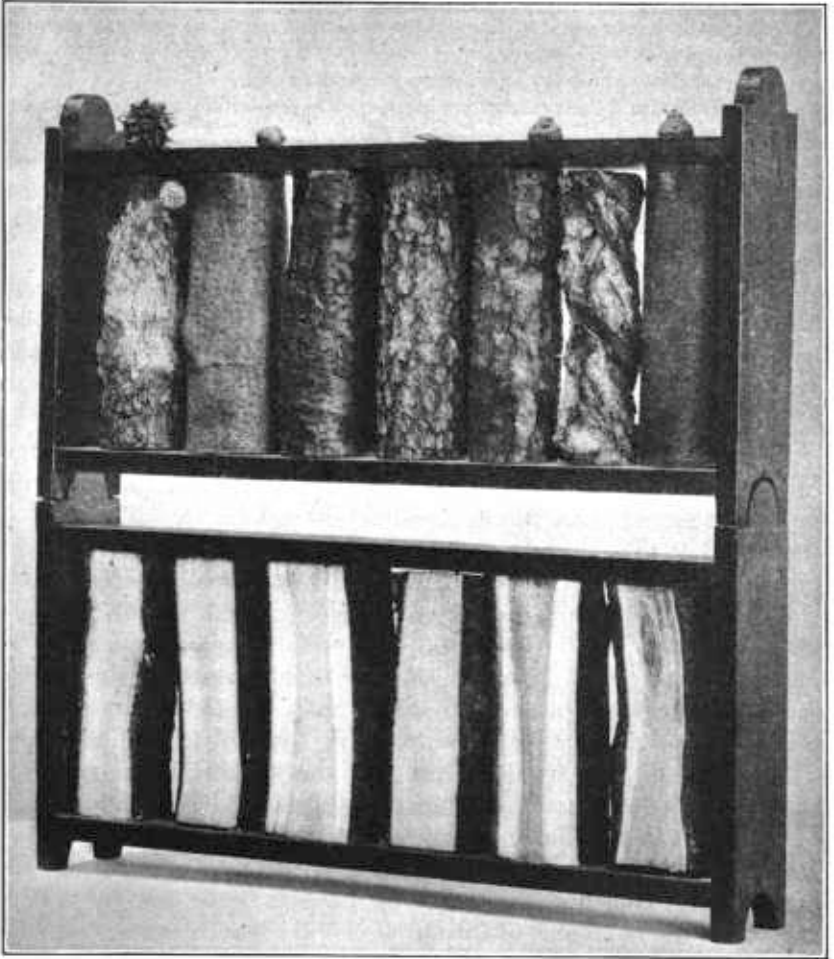


FIG. 13.—Method of mounting tree specimens.

COLLECTION OF COMMERCIAL PRODUCTS OF THE FOREST.

The grocery store, drug store, and housewares store will yield a great variety of products derived originally from the forest. An interesting plan will be to try to secure samples or specimens of all such products, not only in the manufactured form in which they

appear on the market but also in the raw state and in various stages of manufacture. A suggestive list of such products is given below:

Food products, such as the nuts and fruits of forest trees; maple sugar and sirup.

Medicinal products, such as quinine from cinchona, salicin from willow bark, oil of sassafras from sassafras bark, etc.

Small household articles, as matches, toothpicks, clothespins, pencils, pen-holders, tool handles, wooden baskets, shoe pegs, and wooden dishes.

Oils, such as eucalyptus oil, beechnut oil, olive oil, etc.

The products of wood distillation, as wood alcohol, acetates, wood tar, and common potash from wood ashes.

Paper and wood pulp in various stages of manufacture.

Naval stores and their related products, such as turpentine, rosin, creosote, and pitch.

Miscellaneous products, such as cork, tannic acid, charcoal, spruce gum, lamp-black, excelsior, etc.

Some of the products listed, such as maple sirup and sugar, turpentine, wood alcohol, and the various gums and fluids, must, of course, be kept in vials, properly labeled. Perishable fruits should be preserved in alcohol in small jars. Other articles, such as specimens of paper or small articles of woodenware, may be mounted on sheets of cardboard, with labels pasted on the cardboard.

THE USE OF THE MUSEUM.

The materials collected for the Forest Museum should be *used*, not merely displayed. As far as possible the specimens should be so prepared that they may be handled and closely studied by the pupils without injury. Interest soon wanes in blocks of wood or samples of wood products shut up behind glass cases or protected by the warning sign of "Hands off." The child wants to handle the objects he studies, not merely to gaze at them through panes of glass. The materials should be gathered by the pupils themselves as much as possible. They should be encouraged in thinking of the collection as *their* museum. It would defeat this aim to deprive the pupils of the privilege of using and handling the specimens, since they could not but feel that they have a right to use what is their own. .

Of course there will be some specimens, the rare or delicate ones, which will not bear handling and must necessarily be used for display only. But the real value of the museum will come from the "working collection." It is suggested, therefore, that the wood specimens, the samples of wood products, the sets of pictures, or whatever material be obtained for the museum, be prepared and arranged with the aim of use constantly in view. If, in addition, provision can be made for the display of the materials when not in use, this should not be neglected. But at all events the use of the materials should not be sacrificed for the sake of making an attractive display.

APPENDIX.

SUPPLEMENTARY READING BOOKS.

(There are published numerous books containing stories, poems, or short articles, suitable for supplementary reading purposes with reference to these studies of trees and the forest. The following books have been selected as illustrations. Specific reference to the selections contained in these books will be found in connection with the outlines for each term's work.)

1. McMurray: Classic Stories for Little Ones.
2. Cooke: Nature Myths.
3. Holbrook: Book of Nature Myths.
4. Judd: Classic Myths.
5. Hopkins: The Sandman and His Farm Stories.
6. Chase: Buds, Stems, and Roots. (Vol. II, Field and Forest Series.)
7. Wiltse: Kindergarten Stories and Morning Talks.
8. Poulsson: In the Child's World.
9. Wiggin and Smith: Posy Ring.
10. Ford: Nature's Byways.
11. Stone and Fickett: Trees in Poetry and Prose.
12. Stokes: Ten Common Trees.
13. Lovejoy: Nature in Verse.
14. Stevenson: Days and Deeds.
15. Quayle: In God's Out of Doors.
16. Pratt: Little Flower Folk. (Vol. III, Field and Forest Series.)
17. Wiggin and Smith: Golden Numbers.
18. ———: Stories from Garden and Field. (Vol. V, Field and Forest Series.)
19. Dana: Plants and Their Children.
20. Winnington: The Outlook Story Book.
21. Bradish: Stories of Country Life.
22. Boardman: The Lovers of the Woods.
23. Schauffler: Arbor Day.
24. Field: A Little Book of Profitable Tales.
25. Price: The Land We Live In.

REFERENCE BOOKS FOR NATURE STUDY TEACHERS.

Nature study (containing outlines or chapters on forestry, or helpful suggestions on general methods of tree study):

- Comstock: Handbook of Nature Study for Teachers and Parents.
Coulter and Patterson: Practical Nature Study.
Cummings: (a) Nature Study for Primary Grades.
(b) Nature Study for Lower Grammar Grades.

- Holtz: Nature Study.
Hodge: Nature Study and Life.
Holden: Real Things in Nature.
Jackman: Nature Study for Grammar Grades.
McMurray: Special Method in Elementary Science.
Overton and Hill: Nature Study.
Scott: Nature Study and the Child.

Tree Books:

- Apgar: Trees of the Northern United States.
 Brisbin: Trees and Tree Planting.
 Britton: Trees.
 Chase: Cone-Bearing Trees of the California Mountains.
 Collins and Preston: Key to New England Trees.
 Dame and Brooks: Handbook of Trees of New England.
 Emerson and Weed: Our Trees and How to Know Them.
 Flagg: A Year Among Trees.
 Going: With the Trees.
 Hough: Handbook of the Trees of the Northern United States and Canada.
 Huntington: A Study of Trees in Winter.
 Jepson: Trees of California.
 Keeler: Our Native Trees.
 Lounsberry: A Guide to the Trees.
 MacFarland: Getting Acquainted With the Trees.
 Mathews: Familiar Trees and Their Leaves.
 Maury: The Native Trees of Kentucky.
 Mosher: Fruit and Nut Trees.
 Mosher: Our Cone-Bearing Trees.
 Mosher: Oaks and Maples.
 Newhall: Trees of Northeastern America.
 Rogers: Among Green Trees.
 Rogers: The Tree Book.
 Rogers: Trees Every Child Should Know.
 Sargent: A Manual of Trees of North America.
 Schwartz: Forest Trees and Forest Scenery.

Park and Street Trees:

- Fernow: The Care of Trees in Lawn, Street, and Park.
 Solotaroff: Shade Trees in Towns and Cities.

General Forestry:

- Bruncken: North American Forests and Forestry.
 Fernow: Economics of Forestry.
 Fernow: A Brief History of Forestry.
 Gifford: Practical Forestry.
 Graves: The Principles of Handling Woodlands.
 Green: Principles of American Forestry.
 Roth: A First Book of Forestry.

Wood Structure and Woodworking:

- Boulger: Wood.
 Foster: Elementary Woodworking.
 Hough: American Woods (containing thin sections of various species of woods).
 Snow: Principal Species of Wood.

KEY TO COMMON KINDS OF TREES.

By WILLIAM H. LAMB,
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The following key is intended only as a guide in the identification of the more common kinds of trees. It is based on prominent, distinctive characters which can readily be observed by those who have no special training in botany. Most of the terms used require no explanation.

To use the key, decide first, by an examination of the leaf, in which of the following seven sections your tree belongs; then turn to that section and from the descriptions there given determine what kind of tree it is.

	Section.
Trees with needles, or scale-like leaves, mostly evergreens, bearing cones...	I
Trees with broad leaves.	
Leaves simple.	
Alternately attached to twigs.	
With toothed edges	II
Edges neither toothed nor notched.....	III
Opposite on twigs.	
With toothed edges.....	IV
Edges neither toothed nor notched	V
Leaves compound.	
Alternately attached to twigs.....	VI
Opposite on twigs.....	VII

THE CONIFEROUS¹ TREES.

I. Trees with Needles, or Scale-like Leaves, Mostly Evergreen, Bearing Cones.

A. Leaves needle-shaped.

1. Leaves clustered.

- a. Leaves long, from 1 to 18 inches, 2 to 5 in a cluster. Cones large, with many thick, woody scales.....(*Pinus*) **Pine**
- b. Leaves short (less than 2 inches long) in brush-like clusters of 12 to 40; falling off in winter. Cones very small, with thin scales; remaining on tree for one or more seasons.....(*Larix*) **Larch**²

2. Leaves single.

- a. Leaves scattered around twigs; falling off when dry or dead. Cones elongated, with thin scales. Twigs roughened by leaf-scars.
 - x. Leaves stiff, often sharp-pointed and more or less four-sided.....(*Picea*) **Spruce**
 - y. Leaves soft, flat, rounded, or notched at ends, the bases abruptly contracted into thread-like stems.....(*Tsuga*) **Hemlock**

¹ Cone-bearing.

² The larches are peculiar in having single, scattered leaves on the new or terminal twigs produced each season. These should not be mistaken for the "single" leaves borne throughout by other kinds of evergreens.

- b. Leaves in two distinct rows, one on each side of the twig; falling off in late autumn or winter. Cones small, ball-like(*Taxodium*) **Bald cypress**
 - c. Leaves often in two rows on the tops and sides of the twigs; leaves on lower branches mostly flat, those on upper branches stouter. Cones long, erect, forming only on upper side of topmost branches; the scales falling off in autumn, leaving spike-like central axes of the cones attached.....(*Abies*) **Fir**
- B. Leaves scale-like, pointed, overlapping closely on flat or four-sided twigs.
 - 1. Twigs four-sided. Cones round or ball-like, with small, thick scales; seed with very narrow, hard wings.....(*Cupressus*) **Cypress**
 - 2. Twigs flattened.
 - a. Cones elongated, with only a few thin scales; bent back on branches.....(*Thuja*) **Arbor vitae**
 - b. Cones round, very small, berry-like with thin scales; seeds with a broad, thin wing on two sides....(*Chamaecyparis*) **Cedar**
 - c. Cones berry-like (showing no separation into scaly parts). Leaves either short, scale-like, and sharp-pointed, or much longer, needle-like, standing out loosely, and attached in pairs or in threes on the twigs.....(*Juniperus*) **Juniper**

THE BROADLEAF TREES.

II. Leaves Simple, Alternate, with Toothed Edges.

- A. Leaves deeply lobed, or with large notches.
 - 1. Leaves as wide as they are long. Fruit a swinging ball, 1 to 1½ inches in diameter.
 - a. Leaves with finely toothed margins; star-shaped, the divisions pointed. Fruit, bur-like balls, from which, when ripe, small, winged seeds may be shaken. Bark rough.(*Liquidambar*) **Sweet gum**
 - b. Leaves with smooth margins, 3 to 5 inches long, pointed lobes, the space between the lobes rounded. Fruit, a rough ball, easily broken when ripe; composed of closely packed, long, narrow seeds which have hair-like bristles at their lower ends and are attached to a bullet-like central part. Old bark of trunks and large limbs peeling off in thin, curled pieces, leaving pale inner bark showing in irregular patches.....(*Platanus*) **Sycamore**
 - 2. Leaves longer than wide.
 - a. Leaves large with deep, round-topped, or pointed lobes. Fruit, an acorn, resting in a separable cup(*Quercus*) **Oak**
 - b. Leaves small, with little, sharp teeth on margin. Twigs bearing sharp thorns. Fruit small (like a little apple) round, with bony seeds (hard core).....(*Crataegus*) **Hawthorn**
- B. Leaves one-sided (one side of leaf shorter at base than the other side).
 - 1. Leaves large, oval, 5 to 10 inches long, heart-shaped. Fruit, a cluster of small, woody balls $\frac{1}{3}$ to $\frac{1}{2}$ inch in diameter, hanging from a narrow, leaf-like blade.....(*Tilia*) **Basswood**
 - 2. Leaves 3-veined at base, with long, tapering points, which generally turn to one side; edges smooth, or with small teeth of uniform size. Fruit, a small berry about $\frac{1}{4}$ inch in diameter....(*Celtis*) **Hackberry**

3. Leaves with straight veins, oval; edges double-toothed (little teeth on the larger ones). Fruit in clusters, dry, flat, with papery wings all around the seeds.....(*Ulmus*) **Elm**
- C. Leaves even sided (both sides of leaf the same length).
 1. Leaves oval, evergreen, thick, with short needle-like teeth. Fruit, a bright red berry.....(*Ilex*) **Holly**
 2. Leaves more or less elongated, with one tooth at the end of each side vein.
 - a. Trees with smooth, bluish-gray bark, and long, pointed, chestnut-brown buds. Fruit, a small, three-cornered nut, in a spiny husk which splits open at the top into three parts(*Fagus*) **Beech**
 - b. Trees with ridged, grayish-brown bark. Fruit, a large, round nut in a thick husk covered with dense, needle-like spines; the husk splits open from the top into 3 or 4 divisions.....(*Castanea*) **Chestnut**
 3. Leaves very narrow, finely toothed. Small branches slender, usually tough. Fruit, a long cluster of little pods filled with "cotton"(*Salix*) **Willow**
 4. Leaves somewhat triangular in outline, broad at base, large-toothed. Buds of some species coated with aromatic gum. Branches coarse. Fruit, a long cluster of little pods filled with "cotton"(*Populus*) **Poplar**
 5. Leaves oval, pointed, with sawlike teeth.
 - a. Fruit like a tiny pine cone.
 - x. Bark of trunk and branches peeling off in thin sheets. Leaves double-toothed (little teeth on the larger ones). Fruit ("cones") scaly, falling apart when ripe; seeds with gauze-like wings on two sides. (*Betula*) **Birch**
 - y. Bark smooth or broken, but not peeling. Leaves with small teeth. "Cones" hard, woody, not falling apart; seed with narrow wings on two sides. (*Alnus*) **Alder**
 - b. Fruit, a berry; fleshy, edible.
 - x. Leaves large, 3-veined at base, often irregularly, deeply lobed; containing milky juice. Fruit similar in appearance to a blackberry(*Morus*) **Mulberry**
 - y. Leaves small or medium-sized, feather-veined; containing green juice; fruit (cherry or plum) with one seed.
 - i. Seed ("stone") flattened. Fruit large and short-stemmed.....(*Prunus*) **Plum**
 - ii. Seed round. Fruit small and long-stemmed. (*Prunus*) **Cherry**

III. Leaves Simple, Alternate, Edge neither Toothed nor Notched.

- A. Leaves with deep lobes.
 1. Leaves with blunt ends (appearing as if cut off), and with two, pointed, side lobes. Flowers tulip-like. Fruit cone-like, pointed, upright, composed of long, thin, overlapping, winged seeds. Bruised twigs have a peppery odor.....(*Liriodendron*) **Tulip Poplar**
 2. Leaves with rounded ends; oval, often with a lobe on one side, making the leaf mitten-shaped. Bruised twigs and inner bark of trunk sweet-smelling(*Sassafras*) **Sassafras**

B. Leaves without lobes.

1. Bruised twigs with peppery odor.
 - a. Leaves oval (evergreen in one species) or elongated, pointed, large. Flowers large, at ends of branches. Fruit cone-like, with a bright red seed in each division. (*Magnolia*) **Magnolia**
2. Bruised twigs without peppery odor.
 - a. Leaves broader at top than at the base, 8 to 12 inches long, with very short leafstalk. Fruit fleshy, elongated, 3 to 4 inches long, with thick, brown skin when ripe, and large, bony, flat seeds. Buds brown and hairy. (*Asimina*) **Papaw**
 - b. Leaves oval, elongated, 3 to 7 inches long. Fruit, plum-like, round, 1 to 1½ inches in diameter; when ripe, pale orange color; on a very short stalk, surrounded at base with old, hard flower-cup. Fruit very bitter, but edible after frost. (*Diospyros*) **Persimmon**
 - c. Leaves rounded or heart-shaped, 3 to 5 inches across. Flowers pea-like, pink, appearing before the leaves. Fruit, a dry flat pod, 2½ to 3½ inches long; in dense clusters on sides of branches; seeds, hard, small, oblong, ¼ inch long. (*Cercis*) **Red bud**
3. Bruised or cut twigs and leaves with milky juice.
 - a. Leaves with narrow points. Twigs bearing thorns. Fruit, a large, orange-like, rough ball 4 to 6 inches in diameter. (*Toxylon*) **Osage orange**

IV. Leaves Simple, Opposite, with Toothed Edges.

- A. Leaves with large (often lobe-like) teeth. Fruit in pairs, each part with a conspicuous, flat, very thin wing. Fruit matures in spring or in autumn, when it becomes dry and yellowish-brown. (*Acer*) **Maple**

V. Leaves Simple, Opposite, Edges neither Toothed nor Notched.

- A. Leaves very large, heart-shaped. Flowers showy, trumpet-like, in large clusters. Fruit, a long, cylindrical pod, 6 to 14 inches long, containing closely packed, flat, dry seeds, with fringed wings at each end. (*Catalpa*) **Catalpa**
- B. Leaves rather small, oval, tapering at base and point. Flowers conspicuous, white (occasionally rosy), appearing with the expanding leaves. Fruit, a small cluster of two-seeded berries, turning red in autumn. (*Cornus*) **Dogwood**

VI. Leaves Compound, Alternately Attached to Twigs.

- A. Leaflets small, many, attached along two sides of a main stem. Fruit, a flat, bean-like, dry or fleshy pod.
 1. Leaflets with small, wavy teeth. Pods flat, broad, long, often twisted, thin-skinned, with thick, cheesy, sweetish pulp about seeds. Trees with long, keen, branched thorns. (*Gleditsia*) **Honey locust**
 2. Leaflets not toothed.
 - a. Twigs with pairs of short, keen thorns. Leaflets rounded at ends. Flowers showy white, in large clusters. Pods small, flat, thin, dry, with small seeds. (*Robinia*) **Black locust**
 - b. Twigs thornless. Leaflets oval, pointed. Flowers greenish, with violet odor. Pods large, flat, thick, with jelly-like pulp (poisonous) around the large, black-brown seeds. (*Gymnocladus*) **Coffee tree**

B. Leaflets large. Fruit, a hard-shelled nut, with a separable husk.

1. Leaflets narrow at base becoming larger at outer end. Nut light-colored, in a husk which separates more or less completely into four parts when ripe.....(*Hicoria*) **Hickory**
2. Leaflets broad at base, becoming narrower at outer end. Nut dark, rough, in a fleshy husk which is inseparable by any natural divisions and turns black when old. Pith of twigs forms numerous cross-partitions.....(*Juglans*) **Walnut**

VII. Leaves Compound, Opposite on Twigs.

A. Leaflets arranged along two sides of a main leafstalk, with a leaflet at the end.

1. Leaflets generally 3 (sometimes 5), toothed only near the ends. Fruit, a cluster of dry, winged seeds, arranged in pairs like those of maple.....(*Acer*) **Boxelder**¹
2. Leaflets generally more than 3 (3 to 11), and either not toothed or with small teeth. Fruit, a cluster of single-winged, dry, oar-shaped "seeds".....(*Fraxinus*) **Ash**

B. Leaflets (5 to 9) clustered at end of a main leaf-stem. Fruit, a shiny, brown nut in a thick, warty or prickly husk, which separates into several parts.....(*Æsculus*) **Buckeye**

¹ Boxelder, a true maple, differs from the others in having compound leaves.